CAIE IGCSE Chemistry

2.5 Simple molecules and covalent bonds

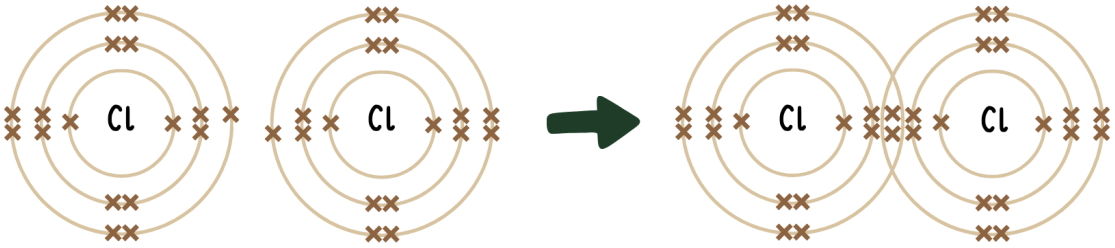
Notes

State that a covalent bond is formed when a pair of electrons is shared between two atoms leading to noble gas electronic configurations

- A covalent bond is formed when a pair of electrons are shared between two atoms (two non-metals)
- This sharing of electrons results in both atoms having a full outer shell (the same as the electronic configuration of a noble gas)

Describe the formation of covalent bonds in simple molecules, including H_2, Cl_2, H_2O, CH_4, NH_3 and HCl. Use dot-and-cross diagrams to show the electronic configurations in these and similar molecules

- Simple, small molecules, such as: HCl, H_2, Cl_2, NH_3, CH_4 have strong, single covalent bonds within their molecules.
- The formation of the single covalent bonds can be shown using dot and cross diagrams
    - The electrons in each atom can be shown as crosses or dots
    - The covalent bond is shown by the outermost shells of the atoms overlapping to show the pair of electrons being shared



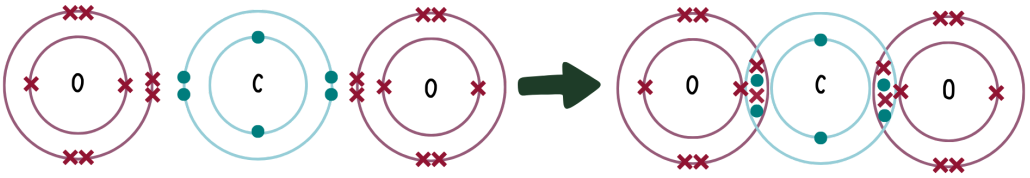
Describe in terms of structure and bonding the properties of simple molecular compounds:

- Simple, small molecules, such as: HCl, NH_3, CH_4 are known as simple molecular compounds

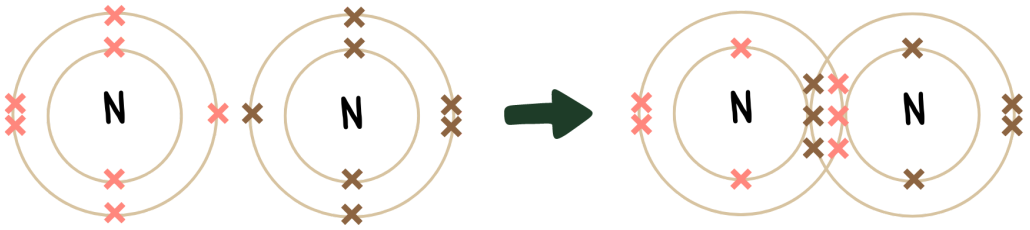
Properties	**Boiling point**	**Melting point**	**Electrical conductivity**	
			When aqueous or molten	**When solid**
Simple molecular compounds	Low	Low	Poor/cannot conduct	Poor/cannot conduct

(Extended only) Describe the formation of covalent bonds in simple molecules, including CH_3OH, C_2H_4, O_2, CO_2 and N_2. Use dot-and-cross diagrams to show the electronic configurations in these and similar molecules

- Simple molecules, such as: CH_3OH, C_2H_4, O_2, CO_2 and N_2 have strong, double or triple covalent bonds within their molecules.
- The formation of the double or triple covalent bonds can be shown using dot and cross diagrams
    - For double covalent bonds (e.g. in CO_2):
    - The electrons in each atom can be shown as crosses or dots
    - A carbon atom needs 4 more electrons and each oxygen atom needs 2 more electrons to achieve noble gas configuration.
    - So each oxygen atom is bonded to the carbon atom with a double covalent bond (2 pairs of electrons are shared between the atoms)
    - The double covalent bond is shown by the outermost shells of the atoms overlapping to show the 2 pair of electrons being shared



    - For triple covalent bonds (e.g. in N_2):
    - Each nitrogen atom needs 3 more electrons to achieve noble gas configuration.
    - So each nitrogen atom is bonded to another nitrogen atom with a triple covalent bond (3 pairs of electrons are shared between the atoms)
    - The triple covalent bond is shown by the outermost shells of the atoms overlapping to show the 3 pair of electrons being shared:



(Extended only) Explain in terms of structure and bonding the properties of simple molecular compounds:

- Simple molecular compounds have **low melting and boiling points** because the intermolecular forces between the molecules are very weak so little energy is needed to overcome them.
    - Simple molecular compounds have strong covalent bonds within the molecules (intramolecular forces) but very weak intermolecular forces between the molecules so easy to break
- Simple molecular compounds have poor electrical conductivity/ **cannot conduct electricity** because there are no ions (charged particles) to carry any charge.